



Visible Vaping: E-Cigarettes and the Further De-Normalization of Smoking

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Abstract

Background: With the growth in the use of electronic cigarettes in many areas concerns have increased that these devices, enabling users to inhale nicotine and flavored liquids in aerosolized form, might result in the renormalization of smoking and ultimately to an increase in smoking prevalence. The current study describes the views and behavior of a sample of non-smokers who have witnessed electronic cigarette use (vaping) on frequent occasions. The aim of the research was to identify whether such visible vaping was having a notable impact on how this sample of non-smokers viewed smoking, their likelihood of starting to smoke and their attitudes towards smoking and vaping.

Methods: Semi structured interviews were undertaken with 100 non-smokers recruited from Scotland and the north of England. Interviews were undertaken by trained peer interviewers, audio recorded and subjected to detailed thematic analysis.

Results: Visible vaping was commonly reported by interviewees who typically interpreted such vaping as indicating that the individual was seeking to reduce or cease his or her smoking. Whilst the sight of someone using an e-cigarette could stimulate curiosity on the part of non-smokers as to what the experience of vaping was like there was little indication that our sample of non-smokers were intending taking up vaping on a regular basis. There were indications from our interviews that visible vaping had resulted in either no change in what individuals assessed as their likelihood of to smoke and for a minority of interviewees visible vaping had resulted in a reduced likelihood of smoking as assessed by interviewees.

Conclusions: To the extent that electronic cigarette use remains distinguishable from smoking combustible cigarettes there is a possibility that vaping may be associated with further de-normalization of smoking.

Keywords

E-cigarettes, Renormalization, Smoking, Young people, Semi-structured interviews

Introduction

For at least the last twenty years a key part of global tobacco control policies has been to de-normalize smoking, that is to turn smoking from being a common place and commonly accepted behavior, to making it an unusual, socially stigmatized and unaccepted behavior. Policies aimed at facilitating the de-normalization of smoking include the requirement to place graphic health warnings on tobacco

packaging, the ban on smoking in enclosed public spaces, the ban on smoking in cars where children are present, the ban on advertising of tobacco products, the ban on the sale of tobacco products to young people, and the requirement to market tobacco products in plain or standardized form. Collectively these tobacco control policies have succeeded in making smoking both less visible and less socially acceptable and, when combined with serial increases in taxation applied to tobacco products, have been shown to be associated with a sustained reduction in smoking prevalence [1-6].

In contrast to the reduction in smoking prevalence that has been witnessed in many countries there has been a marked recent increase in many of the very same countries (including both the U.S. and the U.K.) in the use of electronic cigarettes. According to the U.K. based "Action on Smoking and Health" anti-smoking lobby group, there are approximately 2.8 million e-cigarette users in the UK, of whom the majority (51%) are current smokers, 47% are former smokers and 2% are never smokers [7]. Within the United States, the Centers for Diseases Control and Prevention have estimated that there may be 8.34 million current e-cigarette users (Centers for Disease Control and Prevention, 2016). According to Schoeborn and Gindi [8] around one in ten adults within the U.S. has used an e-cigarette at least once. In the light of those figures it is perhaps not surprising that the e-cigarette industry has been projected to be worth \$50B by 2025 [9].

E-cigarettes have been characterized by Public Health England as being up to 95% less harmful than combustible tobacco products [10]. Recent research from the U.K. has also shown that e-cigarettes may have an important role to play in facilitating smokers quit attempts. Researchers working on the UK based "Smoking Toolkit Study", which involves regular assessments of a large cohort of smokers, have reported that individuals trying to quit smoking using e-cigarettes were more likely to remain abstinent than those seeking to quit using either "over the counter" nicotine replacement or a cold turkey approach [11]. Farsalinos, et al. have recently reported evidence of e-cigarettes having helped a very large number of former smokers to quit smoking drawing upon European wide survey data from over 27,000 vapers [12]. According to the Royal College of Physicians, "e-cigarette use is likely to lead to quit attempts that would not have happened", and in a proportion of these to successful cessation [13].

Alongside such positive assessments, concerns have been expressed regarding the potential adverse impact of e-cigarettes. Attention has been drawn to the unknown harms that may be

associated with long term e-cigarette use [14], to the accuracy in the labeling of e-cigarettes particularly with regard to misleading information on the nicotine content of e-liquids [15]; to the potential of e-cigarettes to increase levels of nicotine dependence [16,17] to the combined use of e-cigarettes and combustible tobacco products [18-20], to the risks of former smokers being reintroduced to nicotine dependence as a result of taking up e-cigarette use after having quit smoking [21], to the risks associated with second hand (passive) vaping [22-24] and to the manufacturing quality of some e-cigarettes with reports of devices exploding and causing burns [25].

Alongside these various concerns, attention has also been repeatedly drawn to the possibility that e-cigarettes might act as both a gateway to smoking and a mechanism through which smoking might be renormalized. Arrazola and colleagues [26] analyzed data from the National Youth Tobacco Survey and identified that e-cigarette use in the last 30 days increased from 1.5% of high school students in 2011 to 13.4% in 2014). Leventhal and colleagues have shown that ninth grade students within the U.S. who had used an e-cigarette were 2.7 times more likely than non e-cigarette users to have initiated smoking over a twelve-month period [27]. Unger and colleagues have reported the results of a survey of 1332 Hispanic young adults (mean age 22.7 years) showing that non-smokers who reported e-cigarette use were more likely to have smoked in the last month compared to non e-cigarette users [28]. Similarly, Wills and colleagues, reported the results of a longitudinal survey of 2338 high school pupils in Hawaii which found that the probability of pupils' smoking was significantly greater in the case of those pupils who had previously used an e-cigarette than amongst those who had not previously used e-cigarettes. The authors of this study have speculated that one possible explanation though which such a gateway effect might be occurring is as a result of the fact that:

...some e-cigarettes mimic the look and feel of cigarettes, and the inhaling and exhaling of e-cigarettes aerosol produces some of the same sensory experiences as smoking a cigarette. This similar experience may contribute towards an inclination towards trying cigarette smoking [29].

Elsewhere Kandel and Kandel have suggested another possible mechanism through which a gateway effect involving e-cigarettes might occur:

Nicotine acts as a gateway drug on the brain, and this effect is likely to occur whether the exposure is from smoking tobacco, passive tobacco smoke, or e-cigarettes [30].

The evidence of e-cigarettes having a possible gateway effect has however been contested by some researchers. Miech and colleagues for example, have recently shown that the proportion of young people using e-cigarettes on a regular basis may be substantially smaller than the number who report any past use. Based on a survey 14,983 school pupils in the US, Miech, et al. report that whilst 26.9% of the pupils had used an e-cigarette in the past, only 4.1% (616) had vaped on more than six occasions in the last 30 days [31]. Similarly, Miech and colleagues have shown that nicotine containing e-liquids were consumed much less frequently by young people than fruit flavored liquids [31]. Similarly, Measham and colleagues, reporting qualitative data from the U.K., found that the attraction of vaping to young people had more to do with the visual appeal of producing large vapor plumes and the variety of available flavors than the issue of nicotine dependence [32].

Alongside the concern that e-cigarette use might act as a gateway to smoking conventional cigarettes attention has also been drawn towards their possible role in renormalizing smoking. According to the World Health Organization:

The renormalization effect refers to the possibility that everything that makes ENDS (electronic nicotine delivery systems) attractive to smokers may enhance the attractiveness of smoking itself and perpetuate the smoking epidemic [33].

Whilst some researchers have cited evidence in support

of a possible renormalization effect associated with the use of e-cigarettes others researchers have questioned whether a smoking renormalization effect linked to e-cigarettes is occurring. Barrington-Trimis and colleagues [34] undertook research looking at the possible relationship between adolescent e-cigarette use and smoking focusing on the extent to which aspects of the home and school environment of 11th and 12 grade pupils in schools in Southern California increased the likelihood of e-cigarette use and smoking (N = 1694). According to the researchers on this study adolescent e-cigarette use, and a positive e-cigarette social environment, were associated with a doubling in the susceptibility to future cigarette use. Barrington Trimis and colleagues note by way of explanation of these findings that:

The societal "denormalization" of cigarette smoking has been a major achievement of tobacco control efforts and is generally recognized as an important reason for the continuing decrease in the prevalence of smoking; however, the increasing social acceptability of e-cigarette use could potentially lead to the social "renormalization" of smoking behaviors more generally, contributing to increased use of e-cigarettes and cigarettes in adolescence [34].

In contrast, Vasiljevic and colleagues identified very little evidence of a renormalization effect from their study of young peoples' reactions to e-cigarette promotional material:

In an experimental study, we found no evidence that exposing English children aged 11-16 years to adverts for candy-like flavored and non-flavored e-cigarettes increased the low appeal of smoking tobacco, the low appeal of using e-cigarettes, or low susceptibility to tobacco smoking. Nor did it reduce the high perceived harm of tobacco smoking.... Our data provide no support for the renormalization hypothesis, since exposure to e-cigarette adverts did not increase the appeal of tobacco smoking in this sample of children [35].

In assessing whether e-cigarette use might be acting as a gateway to smoking or a means of renormalizing smoking there is a need to complement the various quantitative studies surveying relatively large population samples, with more focused qualitative research that can explore whether, and in what ways, e-cigarette use might be having an impact on the social acceptability of smoking and the likelihood of non-smokers initiating smoking. Previous studies have reported in detail on the e-cigarette users views and experiences of vaping [36]. In this paper by contrast, our focus is on the views and experiences of non-smokers/non e-cigarette users who were witnessing visible e-cigarette use within naturally occurring social situations.

In this study we were particularly interested in the extent to which non-smokers/non e-cigarette users felt able to visually differentiate between vaping and smoking, their views of the people they saw vaping, whether they felt their own and other people's attitudes towards smoking had changed as a result of e-cigarette use becoming an increasingly common sight, and whether they felt their own likelihood of starting to smoke had changed as a result of witnessing people vaping.

Research Methods

In this paper we report the results of having undertaken semi structured interviews with "nonsmoking/non e-cigarette users" who had witnessed people vaping in a wide range of social situations. We felt that semi structured, face-to-face, interviews using trained peer interviewers would be one way of eliciting research subjects' views and experiences of visible vaping whilst minimizing the likelihood of producing a response set of more stylized views that might have been produced had we undertaken focus group interviews. Our team of six peer interviewers (three males three females aged from 17 to 30), all of whom received training within the Centre for Substance Use Research on the methods of qualitative interviewing, were requested to recruit individuals who were non-smokers/non e-cigarette users, aged between 16 to 30, and who had witnessed individuals using e-cigarettes. Non-use of e-cigarettes on the part of our interviewees was defined as either no use of an e-cigarette at all or past use of an

e-cigarette on only an occasional, experimental basis.

In total, we interviewed 100 respondents (47 males, 53 females whose average age was 21.2). Interviewees were recruited from Scotland and the North of England from a range of educational/work/social settings. All interviewees were provided with a detailed information sheet on the nature of the research we were undertaking and a signed consent form signaling their willingness to take part in the research. One of the authors (MB), who has extensive experience of qualitative research methods, provided training to all interviewers and provided feedback to each individual interviewer on their first interviews undertaken with research subjects.

The two lead authors on this paper (NM and MB) developed the topic guide for these interviews based on a review of the literature around the possible renormalization effect of e-cigarettes and an exploratory focus group with four young people (aged 17) who were invited to discuss their view of e-cigarettes. The topic guide invited interviewees to describe the circumstances in which they had seen people vaping and whether they had been able to distinguish between visible vaping and smoking, their perception of the various people they had seen vaping, their reactions to visible vaping-including whether the sight of someone vaping had stimulated their own interest in trying vaping, their attitudes towards vaping and smoking-including whether their attitudes towards smoking had changed as a result of witnessing people vaping, whether they felt that the current visibility of vaping had led to a change in the social acceptability of smoking more broadly, and whether in their view their likelihood of smoking had increased, decreased, or remained the same as a result of having seen people using electronic cigarettes. Interviewees were recruited from a wide range of work, leisure and educational settings across Scotland and the North of England and were paid £15 for taking part in the interview process.

All interviews were audio recorded and transcribed by staff within the Centre for Substance Use Research. Individual identifying details were removed from the transcripts which were then read, coded and analyzed by two of the leading authors of the present paper (NM and MB)- both of whom are experienced qualitative researchers. Analysis of the interview transcripts involved reviewing all data extracts around key themes (e.g., recognizing vaping), identifying the most commonly expressed views (how did most interviewees recognize vaping as distinct from smoking) and paying equal attention to both the predominant views and those that were expressed by a minority of respondents. There is a danger in qualitative studies that in writing up the results of either qualitative interviews or observational fieldwork researchers pay disproportionate attention to the most memorable events/views described rather than the most commonly expressed events/views recorded. To further counter this possibility, we have also sought to provide a numerical assessment of the frequency with which various views/attitudes were articulated by interviewees.

Results

Visibility and recognizability of vaping

All of our interviewees had seen people vaping on many occasions and in a wide range of situations:

I've seen people using them walking down the street and they're also getting much more popular. I've seen shops like the Vaper Heaven Shop down in Smithson Street. I've seen people there using them. The engineer I work with uses them, vapes e-cigarettes, so yeah they are obviously popular and getting more popular every day. I've also seen them at music festivals and at gigs, I suppose that's a place where you see them getting used (Female Aged 18).

I see them daily definitely because I think you can smoke them inside some places. I think you now see them more than cigarettes because people can smoke them inside and obviously you can't smoke cigarettes so yeah they're really common I would say. The people you see smoking outside tend to be smoking normal cigarettes because like

I said, inside you can't smoke normal cigarettes so anyone smoking inside are smoking e-cigarettes (Male Aged 19).

When asked whether they felt able to easily distinguish between vaping and smoking the overwhelming majority of our interviewees (96%) said that they had no difficulty in visually differentiating between smoking and vaping. Interviewees cited various features of e-cigarettes use and appearance which they said made it very easy now to differentiate between the two activities referring to such features as the larger, often "tank like" appearance of e-cigarettes, the way in which they were typically held in the palm of the hand with all four fingers and thumb wrapped around the device, the large plumes of expressed vapor, the lack of a noticeable tobacco smell and the types of settings (indoors) where the devices would often be seen being used:

You know it's an e-cigarette 'cause there's not many of the ones that are shaped like normal cigarettes now, they just come in like a pen or like the big chunk package machine ones which are odd and there is certainly more smoke that comes off them, and they do have like a more like pungent smell cause of all the different flavours with the whiter smoke (Male Aged 17).

It's quite noticeably different with the huge vape clouds or whatever (Female Aged 19).

Although the vast majority of individuals commented that they were able to distinguish between vaping and smoking, a significant minority [22] commented that this had not always been the case, and that in the past they had sometimes struggled to determine whether the person was smoking or vaping:

I think the first time I saw them it was one of those ones like a cigarette and I did think it was a real cigarette yes (Male Aged 21).

I remember seeing someone in the supermarket doing it and just thinking they were smoking a cigarette and I remember thinking that was pure weird but that was the first time I'd ever seen it really (Male Aged 23).

It shocked me the first time I saw it. I was on the bus and I was like why is this guy smoking on the bus. Then I realised he was vaping and I was like "oh maybe that's allowed" (Female Aged 18).

By contrast, a very small number of interviewees indicated that they still occasionally felt unsure as to whether the person they were seeing was vaping or smoking:

With ones that are kind of small and disposable, those ones you can't really tell the difference because it's covered in the hand so it just looks like they are smoking something. But like with other ones they are more noticeable because they are bigger and the steam and stuff (Male Aged 17).

The reaction to seeing people vaping

Interviewees were asked about their reaction to the sight of people vaping, whether they were curious about the experience of vaping, what they thought about the people they saw vaping, and whether they felt inclined to initiate vaping themselves. 61% of those interviewed commented that the experience of seeing people vape had made them curious about what the experience of vaping was actually like. Such comments as the following were typical in this regard:

I suppose I am curious as to how it works but I'm not like ever going to take it up (Female Aged 22).

I am curious in a way but I'm not a smoker so it's never really appealed to me (Male Aged 23).

One third of those who commented that the sight of someone vaping had made them curious said that they had subsequently tried vaping. However, none of those who commented that they had tried vaping, having been curious about the experience, described themselves as having initiated a pattern of frequent vaping. Typically, individuals described having tried vaping on a small number of rather unplanned occasions which appeared to have been sufficient to answer their curiosity about the experience of vaping:

My friend was using an e-cig and she was quitting smoking but she had the one without nicotine she liked the feeling of it just in her hand to try to help her quit. So I tried that but it didn't do anything for me. It was a bit pointless (Female Aged 21).

I tried it once but I wouldn't buy my own 'cos I don't smoke. I don't really feel the need to have one and smoke all these different flavours that they have. It doesn't really appeal to me (Male Aged 19).

38% of our interviewees commented that the sight of people vaping had not in any way led them to feel curious about the experience of vaping. Almost all of those who indicated that they had not felt any curiosity as a result of seeing people vape explained this in terms of their perception that e-cigarettes were predominantly being used by smokers as a way of quitting smoking:

I've got no wish to try vaping not at all. I don't smoke so I don't see why I would do it (Female Aged 21).

I've never really been that bothered by it, there's people who have offered me it, like "I've got watermelon flavour do you want to try it?" But it's never really appealed that much to me to be honest. It just kind of seems a bit pointless, like there isn't any really aim to it for me (Male Aged 29).

I probably wouldn't just try it because I don't smoke and just because I don't really like that sort of thing but I do understand it's better than smoking so in a way I do have more respect for the people that are using it to try and quit (Female Aged 19).

Views of smoking and perceived likelihood of smoking

Interviewees were asked whether in their view smoking had become more or less stigmatized as a result of vaping becoming much more visible in recent years. 34% of our interviewees indicated that in their view smoking was now more stigmatized as a result of the popularity of vaping with a number of interviewees expressing their surprise that anybody would now smoke given the availability of what they saw as a less harmful means of consuming nicotine:

I think I hate it even more because I just don't understand why people would still smoke like when there are things like e-cigs around (Male Aged 23).

Yea it has changed in the sense that now that there is a healthier alternative to smoking actual cigarettes yeah I think people should maybe take that into consideration and maybe consider smoking e-cigarettes over actual cigarettes (Female Aged 17).

I think that attitudes towards smoking and smokers have gotten worse. I think there is a much more negative towards smoking than there was back in the day when smoking was a lot more accepted going way back (Female Aged 25).

22% of our interviewees commented that in their view smoking had become less stigmatized as a result of the visibility of people vaping:

I'd say it has become a bit more relaxed because the amount of people you see smoking e-cigs is almost more than smoking cigarettes so I don't know, I'm not quite sure on that question (Female Aged 26).

I would say it (smoking) has become more accepted. For a lot of people it's become a lot more acceptable to see people walking around smoking because of the image of seeing someone walking around with something in their mouth has become a more common because of the vape and the e-cigarette (Male Aged 21).

There are now more options to smoke so it kind of makes it more tailored towards others so more people can do it I guess. So it kind of increases the popularity of smoking (Male Aged 19).

However, the largest proportion of our interviewees (43%) said that in their view the increasing visibility of vaping had not had any notable impact in changing social attitudes towards smoking:

No not really. I feel that they were pretty stigmatised beforehand like it's not seen as particularly cool or anything anymore although a

lot of people have moved on to vaping. But I guess it just doesn't work for some people (Male Aged 19).

No my attitudes towards smoking hasn't changed at all (Female Aged 26).

I think a lot of people just hate smoking altogether and they won't change their view on it (Female Aged 18).

In contrast to the possible impact of vaping on attitudes towards smoking nineteen of our interviewees drew attention to what they saw as the increasing social acceptability (normalization) of vaping itself as something that had occurred in recent years:

Vaping has become more accepted, like it's more incorporated into society. If you see someone smoking a cigarette that smells there, that horrible unpleasantness when you're walking round someone who's smoked or the breath of someone who smokes whereas with e-cigarettes that's not there, it's sort of socially accepted more (Male Aged 18).

I think it's more that vaping has become more accepted because of the aspect of it being cleaner, nicer, you can smoke it in more places. I think smoking cigarettes becomes less accepted actually. I think people who have been smoking their entire lives won't move on to e-cigs, they'll probably carry on until they die but I think the newer generation will definitely move on to e-cigs (Male Aged 22).

Because vaping has become more and more noticeable you are able to distinguish the difference so easily now. I'd say smoking is probably more frowned upon now but vaping is just like a normal thing to see now (Male Aged 16).

To further explore whether the sight of individuals' vaping had increased the likelihood of smoking, interviewees were asked whether in their view they were more or less likely to smoke now as a result of vaping becoming more visible. The distribution of responses to that question was very stark with 84% of respondents indicating that their likelihood of smoking had remained unchanged even despite vaping becoming much more prominent:

Probably the same. I mean I was quite curious of them at first but just as I was with smoking to start with I think it's just sort of a phase that will die out. For me anyway it just doesn't really interest me (Female Aged 21).

Chances of me smoking are zero- it's just not something that I've had any interest in (Male Aged 24).

I'd say it's stayed the same I've been quite opposed to smoking in any form for a long time so I don't think it's changed particularly (Male Aged 21).

14% of our interviewees indicated that their likelihood of smoking had actually decreased as a result of the increasing availability and access to e-cigarettes:

If I was to smoke now I would go for an e-cigarette because I am scared of getting hooked. So I don't want to get hooked so I would go for the e-cigarette (Female Aged 21).

Clearly it is not possible on the basis of the kind of qualitative data that we have collected to comment on the existence of a causal relationship between an increased or decreased likelihood of smoking and the sight of people vaping. Nevertheless, the predominant view of our interviewees was that their likelihood of smoking had not changed as a result of seeing people vape and in a small number of cases they felt that their likelihood of smoking had actually decreased.

Discussion and Conclusions

The data collected in this study were obtained from a sample of non-smokers whose ages ranged from sixteen to twenty-nine. These individuals were interviewed using a semi-structured instrument (topic guide) by peer interviewers trained in the methods of semi-structured interviewing. Interviewees were recruited from a wide range of work, educational, and social settings by our team of peer interviewers.

Clearly, one cannot claim that this sample of 100 interviewees is in any way representative of the large population of non-smokers or of the population of non-smokers that have witnessed people vaping. Ours was an opportunistic sample of non-smokers who had seen people vaping, and from whom we could elicit qualitative information on what they saw as the impact of visible vaping occurring in their social world. Our interest was specifically in examining whether interviewees felt confident in their ability to visually distinguish between smoking and vaping, whether the sight of people vaping had stimulated their own interest in starting to vape, how they saw or regarded people who were vaping, whether they felt attitudes -including their own attitudes towards smokers and smoking -had changed as a result of vaping becoming an increasingly common sight and whether they felt their own likelihood of smoking had increased within the context of more widespread vaping in their social world.

Whilst visible vaping was reported to be a common sight the overwhelming majority of our interviewees appeared to have no difficulty in distinguishing between vaping and smoking with attention being drawn to such elements as the design of the vaping equipment, the lack of a tobacco smell, the way in which devices were held in the hand, and the large plumes of exhaled vapor. Typically, vaping was interpreted as a sign that the individual was trying to reduce his or her tobacco consumption and in this sense it was seen to be something that was socially very distant from the non-smokers we were interviewing. Whilst the sight of someone vaping could certainly induce a level of curiosity as to what the experience of vaping was actually like, we found very little evidence of our non-smokers taking up vaping as a regular behavior or expressing an interest in doing so. Amongst those who indicated that they had tried vaping, after having seen people they knew using e-cigarettes, this largely amounted to exploratory use on a small number of occasions. Similarly, whilst just under a quarter of our interviewees indicated that in their view social attitudes towards smoking had softened as a result of more widespread e-cigarette use there was no indications that this had resulted in individual's judging that their own likelihood of smoking had increased. Rather, it appeared that for the largest proportion of our interviewees the visibility of e-cigarette use had no impact in changing their view of smoking. For some of our interviewees the visibility of people vaping had made smoking seem even less appealing.

The claim that e-cigarettes may be serving to renormalize smoking has been made most forcibly in relation to its possible effect on young people-with a number of researchers pointing to the increased likelihood that young people who have tried an e-cigarette go on to initiate smoking [37-39]. Clearly, there is a need to explore the possible gateway effect between initial use of e-cigarettes and subsequent use of combustible tobacco using surveys that collect data from young people over an extended period of time. Through such surveys it should be possible to quantify the relative risk of smoking initiation on the part of e-cigarette using and non e-cigarette using young people.

However, whilst the issue of smoking renormalization is linked in part to the issue of smoking prevalence (and possible gateway) the concept itself cannot be reduced to a measure of smoking prevalence. The notion of renormalization relates to the social acceptability of the activity- in effect whether smoking is becoming more socially acceptable in the aftermath of visible vaping than was previously the case. On the basis of our data whilst it could be said that e-cigarette use is becoming increasingly normalized in social situations, there did not appear to be strong evidence that vaping was leading to smoking itself becoming normalized. Over half (61%) of our interviewees did not feel that their view of smoking had changed as a result of vaping becoming more visible and one third indicated that in their view social attitudes towards smoking were actually more negative within a context in which e-cigarette use was becoming increasingly common place.

Given the age at which smoking typically starts (early to mid-teens) there is a need to conduct both quantitative and qualitative

research with a younger age cohort than we have studied here to establish whether early teen and pre-teens attitudes towards smoking are changing as a result of the visible use of e-cigarettes. However, the claimed renormalization effect of e-cigarette use has also been suggested to apply to older individuals [39,40]. On the basis of our qualitative interviews with a sample of U.K. non-smokers ranging from those in their mid-teens to their late twenties we have found very little evidence of a renormalization effect occurring.

As has been noted by Voight [41] one of the ways to reduce the likelihood that e-cigarettes might serve to renormalize smoking would be to maintain the visual differences between these activities. To the extent that vaping and smoking are seen as being very different visually and experientially there is a reduced likelihood that increased vaping would lead to smoking becoming more accepted. Indeed, a more likely effect of the growth in the use of e-cigarettes might be the normalization of vaping itself- with some indication in our own data that this may now be occurring. If this is the case, then there may well be merit in seeking to ensure that the existing visual differences between vaping and smoking are maintained.

Within the U.S. the application of recent legislation (Deeming Regulations) have placed restrictions on e-cigarette design and manufacturing which may well see a marked reduction in the availability of the large tank like e-cigarette devices and a return to the smaller, cig-a-like, devices. These regulations are likely to reduce the scope for user modifications of vaping equipment and will likely mean that e-cigarettes appear visually to be much closer to normal cigarettes than is the case at present. In addition, restrictions on the contents of e-liquids will likely see a reduction in the capacity of vapers to produce the distinctive large vapor plumes that were often cited in our research as being key in visually distinguishing between vaping and smoking. Within the European Union (from which the U.K. is currently in the process of withdrawing) similar legislation has been produced (Tobacco Products Directive) which set out regulations governing the design, manufacture, labeling and promotion of e-cigarettes and the constituents of e-liquids. These regulations, as in the U.S., place e-cigarette manufactures under a legal responsibility to provide information on the use and sale of these devices and their impact on public health including their impact on vulnerable i.e., young people. As with the U.S. regulations the E.U. regulations govern maximum refillable tank size (10 milliliters). As a result, these regulations will see the disappearance of the larger refillable tanks that make e-cigarettes very distinctive at present.

In tandem these regulations (both U.S. and E.U.) may well mean that in the future e-cigarettes more closely resemble combustible cigarettes than is the case at present. The danger here, as noted by Voight [41], is that regulation designed to protect public health, and reduce the adverse impact of electronic nicotine delivery systems, give rise to the renormalization phenomenon that others have previously warned about. This would be enormously regrettable given the evidence which we have presented that in their current form e-cigarettes might actually serve an important function in further de-normalizing smoking.

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References

1. Kuipers MA, Beard E, Hitchman SC, Brown J, Stronks K, et al. (2016) Impact on Smoking of England's 2012 Partial Tobacco Point of Sale Display Ban: A Repeated Cross Sectional National Study, *Tob Control*.
2. Levy DT, Chaloupka F, Gitchell J (2004) The Effects of Tobacco Control Policies on Smoking Rates: A Tobacco Control Scorecard. *J Public Health Manag Pract* 10: 338-353.

3. Levy DT, Huang AT, Havumaki JS, Meza R (2016) The Role of Public Policies in Reducing Smoking Prevalence: Results from the Michigan SimSmoke Tobacco Policy Simulation Model. *Cancer Causes Control* 27: 615-625.
4. Levy D, Benjakul S, Ross H, Rittiphakdee B (2008) The Role of Tobacco Control Policies in Reducing Smoking and Deaths in Middle Income Nations: Results from the Thailand SimSmoke Simulation Model. *Tobacco Control* 17: 53-59.
5. Reynales-Shigematsu LM, Fleischer NL, Thrasher JF, Zhang Y, Meza R (2015) Effects of Tobacco Control Policies on Smoking Prevalence and Tobacco Attributable Deaths in Mexico: The SimSmoke Model. *Rev Panam Salud Publica* 38: 316-325.
6. World Health Organisation (2015) Report on the Global Tobacco Epidemic. Geneva.
7. Action on Smoking and Health (2016) Use of Electronic Cigarettes (vaporisers) among Adults in Great Britain.
8. Schboeborn CA, Gindi RM (2015) Electronic Cigarette Use Among Adults: United States, 2014. NCHS Data Brief, 217, US Department of Health and Human Sciences.
9. Business Intelligence Strategy Partner (2016) Electronic Cigarette and E-Vapour (Vaporizer) Market Research Reports.
10. McNeill A, Brose LS, Calder R, Hitchman SC, Hajek P, et al. (2015) E-cigarettes: an evidence update. *Public Health England*.
11. Brown J, Beard E, Kotz D, Michie S, West R (2014) Real-world effectiveness of e-cigarettes when used to aid smoking cessation: A cross-sectional population study. *Addiction* 109: 1531-1540.
12. Farsalinos KE, Poulas K, Voudris V, Le Houezec J (2016) Electronic cigarette use in the European Union: analysis of a representative sample of 27, 460 Europeans from 28 countries. *Addiction* 111: 2032-2040.
13. Royal College of Physicians (2016) Nicotine without smoke: Tobacco harm reduction. London: RCP.
14. Callahan-Lyon P (2014) Electronic Cigarettes: Human Health Effects. *Tobacco Control* 23: ii36-ii40.
15. Goniewicz M, Hajek P, McRobbie H (2014) Nicotine Content of Electronic Cigarettes: its release in vapour and its consistency across batches: regulatory implications. *Addiction* 109: 500-507.
16. Bell K, Keane H (2012) Nicotine Control: E-Cigarettes Smoking and Addiction. *Int J Drug Policy* 23: 242-247.
17. Fillon M (2015) Electronic Cigarettes May Lead to Nicotine Addiction. *JNCI Nat Cancer Inst* 107.
18. Adkison SE, O'Connor RJ, Bansal-Travers M, Hyland A, Borland R, et al. (2013) Electronic Nicotine Delivery System: International Tobacco Control Four Country Survey. *Am J Prev Med* 44: 207-215.
19. Grana R, Benowitz N, Glantz SA (2014) E-Cigarettes a Scientific Review. *Circulation* 129: 1972-1986.
20. Wills T, Knight R, Sargent J, Gibbons F, Pagano I, et al. (2016) Longitudinal Study of e-cigarette use and onset of cigarette smoking among high school students in Hawaii. *Tobacco Control*.
21. Durkin S, Bayly M, Wakefield M (2016) Can E-cigarette Ads Undermine Former Smokers? An Experimental Study. *Tobacco Regulatory Science* 2: 263-277.
22. Goniewicz ML, Kuma T, Gawron M, Knysak J, Kosmider L (2013) Nicotine Levels in Electronic Cigarettes. *Nicotine Tob Res* 15: 158-166.
23. O'Connell G, Colard S, Cahours X, Pritchard JD (2015) An Assessment of Indoor Air quality Before During and After Unrestricted Use of E-cigarettes in a Small Room. *Int J Environ Res Public Health* 12: 4889-4907.
24. Flouris AD, Chorti MS, Poulianiti KP, Jamurtas AZ, Kostikas K, et al. (2013) Acute Impact of Active and Passive Electronic Cigarette Smoking on Serum Cotinine and Lung Function. *Inhal Toxicol* 25: 91-101.
25. Yang L, Rudy SF, Cheng JM, Durmowicz EL (2014) Electronic Cigarettes: Incorporating Human Factors Engineering into Risk Assessments. *Tob Control* 23: ii47-ii53.
26. Arrazola R, Singh C, Corey G, Husten C, Neff L, et al. (2015) Tobacco Use Amongst Middle and High School Students United States 2011-2014. *Morbidity and Mortality Weekly Report* 64: 381-385.
27. Leventhal AM, Strong DR, Kirkpatrick MG, Unger JB, Sussman S, et al. (2015) Association of Electronic Cigarette Use with Initiation of Combustible Tobacco Products Smoking in Early Adolescence. *JAMA* 314: 700-707.
28. Unger JB, Soto DW, Leventhal A (2016) E-cigarette use and subsequent cigarette and marijuana use among Hispanic young adults. *Drug Alcohol Depend* 163: 261-264.
29. Wills T, Knight R, Williams R, Pagano I, Sargent J (2015) Risk Factors for Exclusive E-Cigarette Use and Dual E-Cigarette Use and Tobacco Use in Adolescents. *Pediatrics* 135: e43-e51.
30. Kandel D, Kandel E (2015) The Gateway Hypothesis of Substance Abuse: Development Biological and Societal Perspectives. *Acta Paediatr* 104: 130-137.
31. Miech R, Patrick M, O'Malley P, Johnston L (2016) What are kids vaping? Results from a National Survey of US Adolescents. *Tobacco Control*.
32. Measham F, O'Brien K, Turnbull G (2016) Skittles & Red Bull is my favourite flavour: E-cigarettes, smoking, vaping and the changing landscape of nicotine consumption amongst British teenagers - implications for the normalisation debate. *Drugs: Education, Prevention and Policy* 23: 224-237.
33. World Health Organisation (2014) Electronic Nicotine Delivery Systems. Report by WHO.
34. Barrington-Trimis JL, Berhane K, Unger JB, Cruz TB, Urman R, et al. (2016) The E-cigarette Social Environment, E-cigarettes use and Susceptibility to Cigarette Smoking. *J Adolesc Health* 59: 75-80.
35. Vasiljevic M, Petrescu D, Marteau T (2015) Impact of advertisements promoting candy-like flavoured e-cigarettes on appeal of tobacco smoking amongst children: an experimental study. *Tobacco Control*.
36. Pepper J, Brewer N (2014) Electronic Nicotine Delivery Systems (electronic cigarette) awareness, use reactions and beliefs: a systematic review. *Tob Control* 23: 375-384.
37. Moore G, Littlecott H, Moore L, Ahmed N, Holiday J (2016) E-cigarette use and intentions to smoke amongst 10-11 year olds never smokers in Wales. *Tob Control* 25: 147-152.
38. Wills T, Sargent J, Knight R, Pagano I, Gibbons F (2016) E-cigarette use and willingness to smoke: a sample of adolescent non-smokers. *Tob Control* 25: e52-e59.
39. Unger J, Soto D, Leventhal A (2016) E-cigarette use and subsequent cigarette and marijuana use amongst Hispanic young adults. *Drug and Alcohol Dependence* 163: 261-264.
40. Cataldo JK, Petersen AB, Hunter M, Wang J, Sheon N (2015) E-cigarette marketing and Older Smokers: Road to Renormalization. *Am J Health Behav* 39: 361-371.
41. Voigt K (2015) Smoking Norms and the Regulation of E-Cigarettes. *Am J Public Health* 105: 1967-1972.